PLANT ITEM MATERIAL SELECTION DATA SHEET

R10684974

TLP-VSL-00009A&B, (PTF)
LAW SBS Condensate Receipt Vessels

- Design Temperature (°F)(max/min): 192/40
- Design Pressure (psig) (max/min): 15/-8
- Location: incell
- PJM Discharge Velocity (fps): 40
- Drive Cycle: 25 % (at 40 fps)

ISSUED BY
RPP-WTP PDC

Offspring items

TLP-PJM-00001 – TLP-PJM-00016

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- Normal operating conditions at the stated temperature

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367 or N08926

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance; localized protection is required as discussed in section j)

Process & Operations Limitations:

- None

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 12/07/07

6/13/06

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Corrosion Considerations:

These vessels receive LAW SBS vitrification effluent and effluents recycles from pretreatment including streams from RLD-VSL-00005, RLD-TK-00006A/B, RLD-VSL-00017A/B, and TCP-VSL-00001. 5 M NaOH is used to adjust the pH as needed. Vessels could also receive non-routinely pretreatment off-specification effluents. Wash rings are available. Emptying ejectors, located external to the vessel, are available for emptying vessel heel.

a General Corrosion
The solution is neutral to slightly alkaline pH. According to Hamner (1981) and others, the uniform corrosion rate of 304L and higher alloys at the stated operating temperatures is small, <1 mpy.

Conclusion:
If the temperature remains in the stated operating conditions and the environment remains alkaline, 304L would be satisfactory.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices. Dillon and Koch (1995) are of the opinion that fluoride will have little effect.

Based on the data of Phull (2000) and others, 10,000 ppm chloride at 190°F and at neutral pH requires at least a 6% Mo alloy.

Conclusion:
Localized corrosion, such as pitting, is common and would be a concern for the 300 series stainless steels with the expected halide levels. Under these conditions, 6% Mo alloy or better is required.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. At the stated halide concentration and normal temperatures, a 6% Mo alloy is required.

Conclusion:
Because of the normal operating environment 316L stainless steel is not expected to be acceptable. A 6% Mo is recommended.

e Crevice Corrosion
The pitting discussion covers this area.

Conclusion:
See Pitting

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating temperatures are suitable for microbial growth but, additionally, the location of the system in the process suggests little chance of the introduction of microbes unless introduced by the plant wash system.

Conclusion:
MIC is not expected to be a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a problem in this vessel.

Conclusions
Not considered to be a problem.

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i Vapor Phase Corrosion
The vapor phase portion of the vessel will be spattered with solution and may not be thoroughly rinsed and pitting or crevice corrosion may be a concern. A more resistant 6% Mo alloy is recommended.

Conclusion:
See Pitting.

j Erosion
Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. Based on 24590-WTP-RPT-M-04-0008, a general erosion allowance of 0.016 inch is adequate for components with maximum solids content up to 27.3 wt%. Additional 6% Mo alloy should be provided as localized protection for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 12 m/s with solids concentrations of 3.4 wt% for a usage of 30 % operation as documented in 24590-WTP-M0E-50-00003. The vessels require at least 0.056-inch additional protection. The 3.4 wt% is considered to be conservative and is based on the WTP Prime Contract maximum. During normal operation, the solids content of the vessels is expected to be well below the anticipated maximum.

The wear of the PJM nozzles can occur from flow for both the discharge and reflood cycles of operation. At least 0.036 inch of additional 6% Mo alloy should be provided on the inner surface of the PJM nozzle to accommodate wear due to PJM discharge and suction velocities with solids concentrations of 3.4 wt% for a usage of 30 % operation as documented in 24590-WTP-M0E-50-00003.

Conclusion:
The recommended corrosion allowance provides sufficient protection for erosion of the vessel wall. Additional localized protection for the bottom head will accommodate PJM discharge velocities and for the PJM nozzles will accommodate PJM discharge and reflood velocities.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not expected to be applicable.

Conclusion:
Not a concern.

m Galvanic Corrosion
For the environment and the proposed alloys, this is not believed to be a concern.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid for a limited period.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-WTP-M0E-50-00003, *Wear Allowance for WTP Waste Slurry Systems*
2. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
3. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
4. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
5. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX
6. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
7. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels i FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
8. Smith, H. D. and M. R. Elmore, 1992, *Corrosion Studies of Carbon Steel under Impinging Jets of Simulated Slurries of Neutralized Current Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW)*, PNL-7816, Pacific Northwest Laboratory, Richland, Washington.

Bibliography:

1. Blackburn, LD to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Evaluation of 240-AR Chloride Limit*, August 15, 1991.
2. Danielson, MJ & SG Pitman, 2000, *Corrosion Tests of 316L and Hastelloy C-22 in Simulated Tank Waste Solutions*, PNWD-3015 (BNFL-RPT-019, Rev 0)), Pacific Northwest Laboratory, Richland WA.
3. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
4. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
5. Divine, JR, 1986, Letter to A.J. Diliberto, *Reports of Experimentation*, Battelle, Pacific Northwest Laboratories, Richland, WA 99352
6. Jenkins, CF, 1998, *Performance of Evaporators in High Level Radioactive Chemical Waste Service*, Presented at Corrosion 98, NACE International, Houston TX 77084
7. Jenkins, CF. SRTC, teleconference with JR Divine, RPP-WTP, 16 February, 2000.
8. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
9. Ohl, PC to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Technical Bases for Cl and pH Limits for Liquid Waste Tank Cars*, MA: PCO:90/01, January 16, 1990.
10. Ohl, PC & WC Carlos, 1994, *Hanford High-Level Evaporator/Crystallizer Corrosion Evaluation*, Presented at Corrosion 94, NACE International, Houston TX 77218.
11. Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
12. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
13. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
14. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084
15. Wilding, MW & BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID.
16. Zapp, PE, 1998, *Preliminary Assessment of Evaporator Materials of Construction*, BNF—003-98-0029, Rev 0, Westinghouse Savannah River Co., Inc for BNFL Inc.

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) LAW SBS condensate receipt vessel (TLP-VSL-00009A/B)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	4 08E-02	4 10E-02			
Chloride	g/l	9 69E+00	1 06E+01			
Fluoride	g/l	2 12E+00	2 33E+00			
Iron	g/l	2 08E-02	2 01E-02			
Nitrate	g/l	4 08E-01	3 45E-01			
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l	7 92E-01	2 69E-02			
Carbonate	g/l					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description 24590-PTF-3YD-TLP-00001, Rev 0
Mass Balance Document 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream # TLP12, RLD21
Off Normal Input Stream # (e g , overflow from other vessels) N/A
P&ID 24590-PTF-M6-TLP-P0001, Rev 0
PFD 24590-PTF-M5-V17T-P0005, Rev 0
Technical Reports

Notes:

1 Concentrations less than 1x 10^{-4} g/l do not need to be reported, list values to two significant digits max
2 T normal operation 113 °F (24590-PTF-MVC-TLP-00001, Rev 0)
3 pH approximately 6 8 to 9
4 5M NaOH can be added to these vessels

Assumptions:

4.13.5 LAW SBS Condensate Receipt Vessel (TLP-VSL-00009 A/B)

Routine Operations

The two LAW SBS condensate receipt vessels (TLP-VSL-00009A/B), each with a batch volume of 80,000 gallons, receive LAW SBS vitrification effluent and effluents recycled from pretreatment. These streams include the following:

- LAW SBS condensate from the vitrification SBS condensate vessel (RLD-VSL-00005)
- Off-specification effluent from the process condensate tanks (RLD-TK-00006A/B)
- Off-specification effluent from the alkaline effluent vessels (RLD-VSL-00017A/B)
- Treated LAW concentrate recycle from the treated LAW concentrate storage vessel (TCP-VSL-00001)

LAW SBS condensate is transferred from the LAW vitrification facility to the PT facility through a pipeline installed within an underground trench.

The receipt vessels will alternate duty. One vessel receives LAW SBS condensate, any recycles, and adds 5 M caustic (NaOH) to adjust the pH as needed. A remote sampling point on the LAW SBS evaporator feed line is used to sample for pH and determine necessary adjustments. The second vessel will feed the evaporator system using the variable-speed LAW SBS condensate feed pumps (TLP-PMP-00005A/B), which are controlled by level indication in the separator vessel. The vessels will switch duties as needed/available to keep a continuous feed flow to the evaporator.

Each vessel is equipped with PJMs that blend and maintain solids suspension in the waste.

Non-Routine Operations that Could Affect Corrosion/Erosion

Under infrequent conditions receives pretreatment off-specification effluents. The two receipt vessels (TLP-VSL-00009A/B) will overflow to the ultimate overflow vessel (PWD-VSL-00033). For purposes of decontamination, each vessel is equipped with wash rings.